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SHORT-TERM RISK ASSESSMENT OF INDOOR AIR DATA
50 TUFTS STREET BUILDING

LOCAL HISTORY
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Background

The purpose of this memorandum is to document the evaluation that AMEC Earth & Environmental (AMEC) has undertaken to assess short term risks to potential commercial workers associated with indoor air levels of chlorinated volatile organic compounds at 50 Tufts Street, Somerville, Massachusetts. The risk assessment was performed in accordance with the Massachusetts Contingency Plan (MCP), 310 CMR 40.0951 through 310 CMR 40.0955.

The MCP (310 CMR 40.0006) defines "Imminent Hazard" as a "hazard which would pose a significant risk of harm to health, safety, public welfare or the environment if it were present for even a short period of time." The MCP (310 CMR 40.0953(1)) defines "short period of time" as "five years unless site circumstances indicate that a shorter time period is appropriate." For purposes of this evaluation, AMEC employed the MCP's default value of five years. AMEC assessed the theoretical risk posed to an individual exposed for 8 hours per day, for 5 days per week, for 12 months per year, for 5 years.

The MCP (310 CMR 40.0955) establishes as a threshold for "Imminent Hazard" an exposure, averaged over a typical life expectancy of 70 years, that is associated with a total Excess Lifetime Cancer Risk (ELCR) exceeding 1×10^{-5} (one in one hundred thousand). A total ELCR is calculated by summing the individual ELCRs of each chemical to which an individual is exposed. Calculation of the ELCR after an individual's exposure to a chemical requires identification and evaluation of the chemical's Unit Risk value (UR_i).

An ELCR is therefore calculated according to the equation:

$$ELCR = (Conc.)(URi)\left(\frac{hours}{day}\right)\left(\frac{days}{week}\right)\left(\frac{months}{year}\right)\left(\frac{years}{lifespan}\right)$$

Where:
Conc is the indoor vapor concentration in ($\mu g/m^3$)
URi is the Unit Risk value in $(\mu g/m^3)^{-1}$

In addition, an "Imminent Hazard" exists if the Hazard Index exceeds 1 for constituents that have the potential to cause serious effects following short-term exposures, such as cyanide. For all other constituents, an Imminent Hazard exists if the Hazard Index exceeds 10. None of the site constituents of potential concern have the potential to cause serious adverse effects following short-term exposures, so the criterion for an Imminent Hazard at this site is a Hazard Index of 10.

A Hazard Index is calculated according to the equation:

$$HI = (Conc.)\left(\frac{hours}{day}\right)\left(\frac{days}{week}\right)\left(\frac{months}{year}\right)\left(\frac{years}{lifespan}\right) / RfC$$

Where:
Conc is the indoor vapor concentration in (mg/m^3)
RfC is the Reference Concentration value in (mg/m^3)

Constituents of Potential Concern

AMEC has evaluated the indoor air sampling data from June 28, 2007. The samples included in the analysis are all seven samples taken from indoor locations, which include samples labelled NW, NO, SO, NC, GA, SC, and IA. Sample IA is a duplicate indoor air sample collected at location SC. Three constituents were detected in at least one sample: PCE, TCE, and 1,1,1-trichloroethylene. Three other constituents were not detected in at least one sample, but they have been detected in site groundwater: 1,1-dichloroethane, *cis*-1,2-dichloroethylene, and 1,1-dichloroethylene. All six constituents were evaluated in the short term risk assessment. In accordance with standard risk assessment practice, non-detects were assigned a surrogate value of one-half the sample quantitation limit.

Exposure Point Concentration

The Exposure Point Concentration used for the short term risk assessment was the mean of the six sampling locations, which includes the average concentration of SC and its duplicate IA.

TABLE 1
EXPOSURE POINT CONCENTRATIONS

Constituent of Potential Concern	Exposure Point Concentration (ug/m^3)[1]
Tetrachlorothylene (PCE)	15.6
Trichloroethylene (TCE)	0.62
1,1,1-trichloroethane	0.61
1,1-dichloroethane	0.41
cis-l,2-dichloroethylene	0.40
1,1-dichloroethylene	0.40

[1] Mean of samples NW, NO, SO, NC, GA, and SC/IA taken on June 28, 2007.

Toxicity Assessment

AMEC evaluated the regulatory toxicology literature and identified the most up-to-date Reference Concentrations (RfCs) and Unit Risk Values (Ur_is) to characterize the risk to human health from constituents of potential concern that are associated with noncarcinogenic effects and those that are associated with carcinogenic effects, respectively. The toxicity values are shown in Table 2.

TABLE 2
TOXICITY VALUES

Constituent of Potential Concern	Reference Concentration (RfC) (mg/m^3)	Source	Unit Risk Value (Ur_i) $(ug/m^3)^{-1}$	Source
Tetrachlorothylene (PCE)	4.6	MADEP	5.5E-05; 6.0E-06	MADEP; USEPA
Trichloroethylene (TCE)	0.18	MADEP	1.7E-06; 2.0E-06	MADEP; USEPA
1,1,1-trichloroethane	5.2	MADEP	Not applicable	MADEP
1,1-dichloroethane	0.5	MADEP	Not applicable	MADEP
cis-l,2-dichloroethylene	0.035	MADEP	Not applicable	MADEP
1,1-dichloroethylene	0.2	MADEP	Not applicable	MADEP

Unit Risk Values for PCE and TCE

During AMEC's evaluation of the regulatory toxicology literature, it focused on PCE and TCE URi values associated with carcinogenic effects. The most current UR_i values are U.S. EPA values. For PCE, EPA's most recent UR_i is 6×10^{-6} $(\mu g/m^3)^{-1}$. This value was published in December 2005 by EPA Region VI, December 2004 by EPA Region IX, November 2005 by the EPA Office of Air Quality Planning and Standards (Prioritized Chronic Dose Response Factors), and in February 2005 by the EPA Office of Air Quality Planning and Standards (Perchloroethylene Dry Cleaners Refined Human Health Risk Characterization). The same value is also the current value used in the States of California, New Jersey, Colorado, New Hampshire and others.

For TCE, the most recent EPA UR_i is 2×10^{-6} $(\mu g/m^3)^{-1}$. This value was published in November 2005 by the EPA Office of Air Quality Planning and Standards (Prioritized Chronic Dose Response Factors).

The above described UR_i values from the U.S. EPA are the most recent dose-response values from the U.S. government and are based on the most current scientific evidence available.

MADEP has published different UR_i values for PCE and TCE that were derived many years ago. Specifically, MADEP derived a UR_i for PCE in 1987 (5.5×10^{-5} $(\mu g/m^3)^{-1}$). For TCE, MADEP is currently listing a UR_i value of 1.7×10^{-6} $(\mu g/m^3)^{-1}$ on its website. This UR_i was designated by the EPA Office of Air Quality Planning and Standards in January 2000 as a Provisional Inhalation Unit Risk in the Tetrachloroethylene (Perchloroethylene) Hazard Summary.

The MADEP-listed URi for TCE is very similar to the most recently issued UR_i from the U.S. EPA. On the other hand, the MADEP-listed UR_i for PCE is out of date. Simply put, the MADEP unit risk factor for PCE, which was derived by the Department in 1987, was not derived in a manner that is consistent with prevailing scientific and regulatory practice. For instance, it was derived from a rodent ingestion study with PCE that was stabilized with epichlorhydrin, a known rodent carcinogen; it was based on total PCE metabolites whereas all recent studies of PCE view trichloroacetic acid formation as the appropriate dose metric, not total metabolites; it used the old approach for cross-species scaling of dose that was replaced a decade ago by all regulatory agencies (i.e., $BW^{2/3}$ approach versus $BW^{3/4}$ approach); and it assumed linearity at low doses despite the fact the PCE's "mode of action" is generally recognized by the toxicology community to be cellular toxicity or peroxisomal proliferation, both of which would require non-linear dose-response functions. In addition, there has been a volume of additional toxicological work on PCE that has been performed in the last 20 years, which render the MADEP-derived 1987 unit risk factor outdated. Such research includes: additional rodent-human comparative metabolism studies, EPA's Human Equivalent Concentration methodologies, and many comprehensive PCE-specific physiologically based pharmacokinetic models.

In this document, AMEC has calculated the risks to potential commercial workers for a short period of time (five years) using two sets of Unit Risk Values. First, the most recent values from the U.S. Environmental Protection Agency are used, because these UR_i values are the most up-to-date values based on current science. Second, for purposes of comparison, the MADEP-listed values also are used, because, according to MADEP, they have not been withdrawn from use for risk assessments under the MCP.

Results

Using both U.S. EPA's and MADEP's UR_is for PCE and TCE and MADEP's RfCs for all constituents of potential concern and the previously discussed "Imminent Hazard" exposure assumptions for short term exposures, AMEC has determined that the short term risks for a potential commercial worker in the 50 Tufts Street building do not exceed MADEP's criteria for "significant risk" for a short period of time.

TABLE 3
RISK ASSESSMENT RESULTS FOR A SHORT PERIOD OF TIME

Location	UR_i Values For PCE & TCE*	Hazard Index	Excess Lifetime Cancer Risk
50 Tufts Street, June 28, 2007 Indoor Air Data	U.S. EPA Values	0.005	2E-06
50 Tufts Street, June 28, 2007 Indoor Air Data	MADEP Values	0.005	1E-05

Hazard Index Criterion: HI = 10
Excess Lifetime Cancer Risk Criterion: ELCR = 1E-05.
* All RfC values for noncarcinogenic risk assessment are MADEP values.

References

MADEP. 1987. CHEM AAL www.mass.gov/dep/toxics/percdoc.htm

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U.S. EPA Office of Air Quality and Standards. 2005. Prioritized Chronic Dose Response Factors. Technology Transfer Network Air Toxics Website
http://www.epa.gov/ttn/atw/toxsource/summary.html

amec

UniFirst Corporation
50 Tufts Street
Somerville, MA
6/28/07 Data

AVERAGE

Compound(1)	Conc (ug/m^3)	EPA URF (ug/m^3)$^{-1}$	RfC (mg/m^3)	Hours/Day	Days/Week	Months/Year	Years	ELCR	HI - Noncancer
1,1 Dichloroethane	0.405	NA	0.5	8	5	12	5	NA	2.E-04
cis-1,2-Dichloroethylene	0.395	NA	0.035	8	5	12	5	NA	3.E-03
1,1-Dichloroethylene	0.395	NA	0.2	8	5	12	5	NA	5.E-04
PCE	15.633	6.0E-06	4.6	8	5	12	5	2.E-06	8.E-04
1,1,1-Trichloroethane	0.608	NA	5.2	8	5	12	5	NA	3.E-05
TCE	0.618	2.0E-06	0.18	8	5	12	5	2.E-08	8.E-04
							TOTAL	2.E-06	5.E-03

(1) The concentration used for each compound is an average of the following locations: north warehouse, north office, south office, north central warehouse, garage, south central warehouse, and duplicate of south central warehouse.

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UniFirst Corporation
50 Tufts Street
Somerville, MA
6/28/07 Data

AVERAGE

Compound(1)	Conc (ug/m^3)	DEP URF $(ug/m^3)^{-1}$	RfC (mg/m^3)	Hours/Day	Days/Week	Months/Year	Years	ELCR	HI - Noncancer
1,1 Dichloroethane	0.405	NA	0.5	8	5	12	5	NA	2.E-04
cis-1,2-Dichloroethylene	0.395	NA	0.035	8	5	12	5	NA	3.E-03
1,1-Dichloroethylene	0.395	NA	0.2	8	5	12	5	NA	5.E-04
PCE	15.633	5.5E-05	4.6	8	5	12	5	1.E-05	8.E-04
1,1,1-Trichloroethane	0.608	NA	5.2	8	5	12	5	NA	3.E-05
TCE	0.618	1.7E-06	0.18	8	5	12	5	2.E-08	8.E-04
							TOTAL	1.E-05	5.E-03

(1) The concentration used for each compound is an average of the following locations: north warehouse, north office, south office, north central warehouse, garage, south central warehouse, and duplicate of south central warehouse.

Table 1
Summary of Indoor Air Testing Results
50 Tufts Street
Somerville, MA

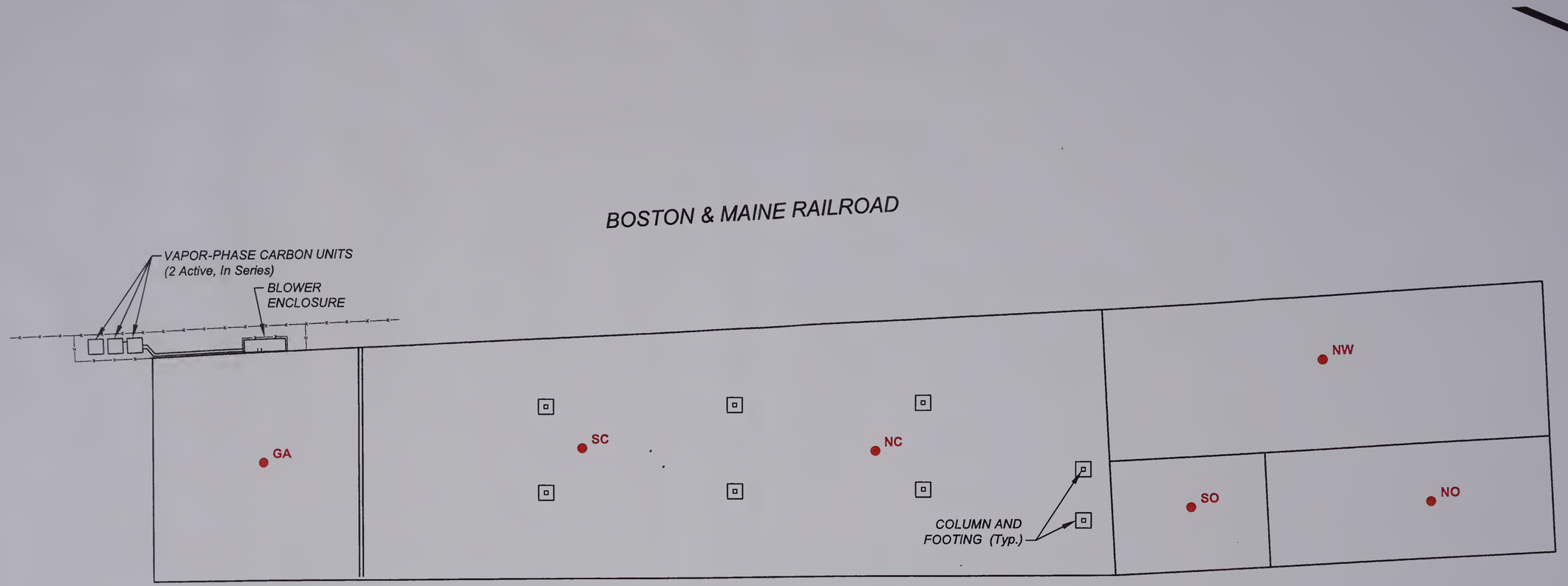
	Sample Location:	NW		NO		SO		NC		GA		SC		IA (Duplicate of SC)	
	Sample Name:	045162-NW		045162-NO		045162-SO		045162-NC		045162-GA		045162-SC		045162-IA	
	Sample Date:	6/28/07		6/28/07		6/28/07		6/28/07		6/28/07		6/28/07		6/28/07	
	Collected By:	GEI		GEI		GEI		GEI		GEI		GEI		GEI	
	Units:	µg/m³	ppbV	µg/m³	ppbV	µg/m³	ppbV	µg/m³	ppbV	µg/m³	ppbV	µg/m³	ppbV	µg/m³	ppbV
Analyte	Method														
Volatile Organic Compounds (VOCs)	TO-15														
Carbon tetrachloride		0.69 J	0.11 J	0.61 J	0.097 J	0.69 J	0.11 J	0.60 J	0.096 J	0.69 J	0.11 J	0.69 J	0.11 J	<1.3	<0.20
1,1 Dichloroethane		<0.81	<0.20	<0.81	<0.20	<0.81	<0.20	<0.81	<0.20	<0.81	<0.20	<0.81	<0.20	<0.81	<0.20
cis-1,2-Dichloroethylene		<0.79	<0.20	<0.79	<0.20	<0.79	<0.20	<0.79	<0.20	<0.79	<0.20	<0.79	<0.20	<0.79	<0.20
1,1-Dichloroethylene		<0.79	<0.20	<0.79	<0.20	<0.79	<0.20	<0.79	<0.20	<0.79	<0.20	<0.79	<0.20	<0.79	<0.20
Tetrachloroethylene (PCE)		15 G	2.2 G	8.8 G	1.3 G	18 G	2.7 G	16 G	2.3 G	22 G	3.2 G	18 GP	2.6 GP	10 GP	1.5 GP
1,1,1-Trichloroethane		0.60 J	0.11 J	0.87 J	0.16 J	0.55 J	0.10 J	<1.1	<0.20	<1.1	<0.20	0.50 J	0.092 J	<1.1	<0.20
Trichloroethylene (TCE)		<1.1	<0.20	0.70 J	0.13 J	0.81 J	0.15 J	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20	<1.1	<0.20

General Notes:

1. Analytes detected in at least one sample are reported here. For a complete list of analytes see the laboratory data
2. µg/m³ = micrograms per cubic meter.
3. ppbV = parts per billion by volume.
4. "<" = The analyte was not detected at a concentration above the specified laboratory reporting limit.

Qualifying Notes:

J The reported result is below the laboratory reporting limit and is estimated.
G Laboratory duplicate precision outside control limits.
P The reported result is estimated due to field duplicate precision outside control limits.



LEGEND:

- ● GA — INDOOR AIR MONITORING LOCATION (3'-9" ABOVE SLAB)

GA	GARAGE AREA
NC	NORTH CENTRAL WAREHOUSE
NO	NORTH OFFICE
NW	NORTH WAREHOUSE
SC	SOUTH CENTRAL WAREHOUSE
SO	SOUTH OFFICE

NOTES:

1. FIGURE BASED ON PLAN TITLED "INTERSTATE UNIFORM ADDN., TUFTS STREET SOMERVILLE, MASS." BY STRUCTURAL SYSTEMS, INC. DATED 12-2-76.

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APPROXIMATE SCALE, FEET

50 Tufts Street Building
Somerville, Massachusetts

UniFirst Corporation
Wilmington, Massachusetts

GEI Consultants

INDOOR AIR SAMPLING LOCATIONS

Project 04516-2 | July 2007 | Fig. 1

N: 04516-2-144 ljw/ptc/djm 7/31/07